

Memorandum M-2596

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Division 6 - Lincoln Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BIWEEKLY REPORT FOR January 1, 1954

To: Jay W. Forrester

From: Division 6 Staff

CLASSIFICATION CHANGED TO:

Auth: DD254By: R.R. EverettDate: 2/1/60

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SECTION I - CAPE COD SYSTEM

1.1 Group 611.10 General

(C.R. Wieser) (CONFIDENTIAL)

John Newitt has been chosen to represent Division 6 in matters pertaining to the layout of display consoles for the XD-1 prototype computer (electronic design of the display system is still the responsibility of Corderman). All comments on console layout should be directed to Newitt, and cooperation is requested in getting to him the data necessary for completion of a layout. A series of cardboard console mockups is being built and can be seen in Room 228, Barta. Comments are requested.

The order code for the XD-1 computer has been frozen and will not be modified until some experience in running the machine has been obtained. IBM and MIT will prepare a programmer's manual based on the order code, and Bill Lone will represent MIT in this task (see Lone's section of this biweekly).

(R.J. Horn, Jr.) (CONFIDENTIAL)

Summary

Direction Center activities were very limited this past biweekly period due to an agreement with the Air Force to limit large-scale tests so that more Christmas leaves could be given.

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SECURITY INFORMATION

1.10 General (Continued)

(R.J. Horn, Jr.) (CONFIDENTIAL) (Continued)

The Air Defense Command is sending three groups of controllers to the Laboratory for ten-day visits. The first visit will begin on 4 January.

The radar-accuracy test program using the M-33 tracking radar is running with increasing success. In connection with another study of tracking accuracy, a program is being written to use radar data recorded at the same time as Raydist data.

A dual tracking program to calibrate any gap filler against South Truro is now available.

A program to display eight scans of radar past history will soon be operative.

The radar-mapping monitor scope may now be switched to monitor either of the two gap-filler radars or the South Truro long-range radar.

The automatic ground/air data-link test program is continuing in conjunction with Group 22. The data link will not be used operationally in Cape Cod tests until it has proven reliable.

In connection with XD-1 activities, a floor plan for the Direction Center at Bedford has been submitted to Division 7, the XD-1 order code has been frozen and a programmer's manual will be compiled with IBM, and cardboard console mockups are available for comment in Room 228. Console comments should be made to John Newitt.

1.11 Equipment Engineering

(N. Alperin) (CONFIDENTIAL)

Eleven light guns have been modified and the sensitivity adjusted. Most of the plug-in units for the light guns have been delivered and have to be tested.

I hope to have the new system installed 11 January.

If a light gun or the light cannon is found to be inoperative during the morning calibration periods, please do not wait to report the trouble when the period is over. If Charlie Greim is notified as soon as trouble is found, there is a good chance that it can be cleared up before calibration is finished.

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1.11 Equipment Engineering (Continued)

(H.J. Kirshner) (CONFIDENTIAL)

A filter which is a part of the digital-radar-relay equipment has been reinstalled after its repair by United Transformer Co. Aside from the down time necessitated by the repair of the above mentioned filter, performance of this relay link has been steadily improving during the past several weeks.

Some trouble has been encountered with the tape-transport mechanisms of both Ampex 14-track recorders. Remedial steps are being taken to alleviate the difficulties.

Most of the equipment necessary to finish the installation of the SDV monitor station in Room 224 has been installed.

(D. Neville) (CONFIDENTIAL)

I have spent the past two biweekly periods working with Lee Murray in the operational aspect of the data link. An attempt is being made to collect enough data on message reception to make an evaluation of the link system. So far results have been practically nil due to equipment failures in all stations of the link.

(A.V. Shortell, Jr.) (CONFIDENTIAL)

The monitoring scheme was finally installed on 28 December. By means of the rotary switch on the monitor scope Y30, this scope can monitor the output of any of the mapping scopes. Switch positions 1, 2, and 3 will monitor Y31, Y32, and Y33, respectively, with position 4 being the off position.

The illuminating scheme is being redesigned, and parts for it should be constructed during the coming biweekly period.

Work on the circuitry for a new scan synchronizer has been suspended pending a decision on the use of IBM's synchronizer with the new mappers.

At present I am modifying the sweep circuits on the Pathfinder scope received this week. This modification will enable us to test the intensification circuitry being designed by S. Ginsburg.

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SECURITY INFORMATION

1.12 Data Screening

(R.L. Walquist) (CONFIDENTIAL)

Calibration of the Cape Cod radar network is still not completed. Although attempts at calibration have been made, a combination of poor weather and lack of an aircraft with a bombsight have aborted all these attempts. However, on Wednesday, 30 December, we were finally able to obtain the unusual combination of good weather and a B-29 with a bombsight; on this day the computer system decided to have a power failure. As a result, the calibration test again had to be cancelled. If circumstances do not remain against us, we hope to complete our calibration in the near future. Initial tests with the calibration program have established a definite misalignment between South Truro and the gap fillers that we normally use. However, without a check point that is external to the radar network, it is not possible to determine the exact degree to which the various sets are in error.

The modification to the TWS section of the Cape Cod program to utilize Mark X data now appears to be operative. However, we have had trouble in obtaining good data from the Mark X set because of azimuth calibration difficulties at the radar site. According to H. Logemann, the azimuth calibration exhibits a long-term drift, the exact nature of which is not known. As a result, the set can be calibrated correctly in azimuth and be out of calibration a few hours later. Logemann hopes to correct this difficulty in the near future. Tests to date indicate that the blip-scan ratio for the Mark X is very good, being practically unity for aircraft out to greater than 150 miles. It appears that the only time the blip-scan ratio becomes poor is when the aircraft turns and shields its Mark X antenna.

The past-history program being written by H. Peterson has been crudely checked out and is very nearly operative. The eight-scan display of radar data is quite enlightening as to the quality of the radar data and the difficulty in tracking aircraft in the Cape Cod System. It appears that the display will be very helpful to monitors in determining what has happened in difficult tracking situations. There is still some question as to whether eight scans of past history will be sufficient.

Some discussion was held with C. Zraket and W. Attridge on various SOP's for interceptor guidance. The purpose of these SOP's is to enable the track monitors to know what to expect of interceptors without requiring the continuous transfer of information over the telephone lines as is now being done. These SOP's should improve the tracking and assist the monitors until a more automatic means of communication via the computer program is developed. In line with this improvement of the manual operation of the System, a program is in preparation which will display to the Track Monitor the command heading of all interceptors in tracking difficulty.

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1.12 Data Screening (Continued)

(R.L. Walquist) (CONFIDENTIAL)(Continued)

A discussion has been held with Ed Rich and C. Wieser on various methods of checking out the IBM mapper unit, which is to be delivered to the Laboratory in the latter part of January. It was decided that we should use the computer and a test program to test the mapping unit and to obtain quantitative figures on how well it operates. The details of this program are being worked out by some of the members of the Data Screening Group.

(W. S. Attridge) (CONFIDENTIAL)

Operation of the Cape Cod System and training of the Air Force personnel was cancelled during the past two holiday weeks. Attempts to have radar calibration and Mark X tests were thwarted by lack of proper aircraft and equipment.

C. Zraket and I have organized standard operating procedures to aid in tracking and control of interceptor aircraft. These SOP's will be issued as an M-Note.

(J. Levenson) (CONFIDENTIAL)

A data-analysis program for the tracking and monitoring sections of TWS should be checked out early in the next biweekly period. The new parameter-insertion program is completely checked out and will be used as one of the Group O utility programs. Instructions for its use will be distributed as soon as all previous parameters have been converted for use by this program.

(H. Peterson) (CONFIDENTIAL)

The past-history display is now operative. A similar program has been written that avoids use of the changeable constants in the 2700's (octal), thus making it possible to use FTU tracks.

I recommend that the current frame be taken off the past-history display line.

(H. Seward) (CONFIDENTIAL)

A program to check the data-transmission characteristics of this buffer drum has been written and tested out. The program collects data from one radar set through the buffer drum and also through the present MITE equipment for a variable time interval. After this collection interval the returns are compared for identity to determine which returns were rejected by the buffer drum.

A computer program for testing and evaluating the radar mappers is being outlined with J. Levenson and J. Ishihara.

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1.12 Data Screening (Continued)

(E. W. Wolf) (CONFIDENTIAL)

Calibration missions were flown on 22 December and 30 December. The weather, the computer, and the lack of a bombsight on 22 December all conspired to prevent any data useful for calibrating South Truro from being obtained on either date. Another mission is scheduled for 6 January 1954.

Data from one Mark X checkpoint were obtained. The indicated range and azimuth were 28 nautical miles and 195 azimuth units, respectively. This compares well with the true range and azimuth, which are 27.52813 nautical miles and 194.571 azimuth units, respectively.

Mark X data were also used to track an aircraft on a due westerly course at a height of 20,000 feet. The range extended from 10 to 116 miles. Returns were received every scan as long as the aircraft flew a straight-line course, but returns were generally not received when the plane was turning, probably because of the shielding of the antenna by the plane's body.

The dual-tracking calibration program is now operational. This program will allow the calibration of any gap-filler radar against South Truro, provided South Truro is calibrated. Since South Truro has not yet been calibrated, only relative calibration errors can be established. The program has already been used to determine that the relative calibration error between South Truro and Derry is between 3 and 5 miles at a range of 99 miles and an azimuth of 228 units. There is no relative azimuth-calibration error.

(W. Wolf) (CONFIDENTIAL)

The circle-calibration program for calibrating the expansion knobs at the G stations was modified to include circles about Otis and Bedford. The radius of expansion was reduced because the circuits built to perform the expansion could not handle a radius of 0.707 times the maximum radius of 160/178. An acceptable radius for expansion was found to be 0.5313 times the maximum radius. The scopes are calibrated to handle this expansion. The calibration program will be included in the Group 0 utility program which works as such but is being modified to include the parameter insertion and the circle calibration.

A conference with members of Group 22 was attended with R. Walquist and J. Ishihara. Data analysis was among the topics of discussion.

The data "filter" program which manually filters tracks from other data has been run and shows area for improvement. It appears that fewer than 64 scans but more than 20 scans are needed to determine tracks. A data-analysis section must be added to obtain numerical results.

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1.13 Tracking and Control

(W. Lone) (CONFIDENTIAL)

On 21 December I visited Poughkeepsie to review the supplement to TR-7, the manual describing the XD-1 order code. It is expected that the manual will be completely revised. Any comments or suggestions for improvement will be welcome.

It was suggested that we adopt a three-letter code for all orders. IBM is in agreement on this point.

A large portion of the biweekly period was spent in planning how some of the XD-1 utility programs will be written. A memo will be written describing the proposals for their use by programmers.

(A. Mathiasen, B. Stahl) (CONFIDENTIAL)

The radar-accuracy test program, using the M-33 tracking radar previously located at the Belmont AAA site (see biweekly of 10/23/53), has been run on the computer several times with increasing success with each trial. It is expected that the required data will be forthcoming upon another session.

It has been found that the nature of the data from Raydist equipment (see biweekly of 11/20/53) is such that it is more advisable to write a completely new program than to try to adapt the present radar-accuracy program to new data. A program is being written at the present time to use radar data recorded at the same time as Raydist data. All work on the Raydist project is being done in connection with G. Harris and I. Resnick of Group 22. In addition, conferences have been held with Newton Mas of Raydist Navigation Corporation on the use and interpretation of Raydist data; and a visit was made to observe the Raydist operations at the temporary installation at Scituate. Several flight tests have been recorded on magnetic tape for future reprocessing, and a more detailed report will follow the conclusion of our analysis of these tests.

(B. Stahl) (CONFIDENTIAL)

A program is being written to remove (and convert for delayed print-out) data previously stored temporarily on the drum by the radar-accuracy test program. Another program being written will use live or previously recorded radar data in connection with data from Raydist. Originally, it was felt that a program by E. Wolf would be used for this interpretation of the radar data, but additional requirements upon the program have made it advisable to write another, although along similar lines.

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1.14 Weapons Direction

(D. R. Israel) (CONFIDENTIAL)

Preparations for the detailed evaluation of the Weapons Direction functions continue. Definite proposals and plans for the evaluation of each operating position have been prepared. Both live and simulated data will be used when the evaluation starts early next month.

Work on the preparation of descriptive memos and standard operating procedures continues, and the memos on the height and identification functions are ready for publication.

Preparations are now being made for the scheduled visits of ADC operational personnel during the month of January. Three groups of three controllers each will make 9-day visits beginning 4 January. A detailed program of indoctrination, participation in Cape Cod operation, and discussion of operational problems has been set up. C. Grandy and I will administer the program in which a large part of Group 61 will participate. A memorandum outlining the 9-day program will be issued on 4 or 5 January.

(H. D. Benington) (CONFIDENTIAL)

The evaluation program for display toggle switches and Digital Information Displays was developed. Forms will be given to all the evaluators specifying the standard displays that should be used at the consoles; the switches used in addition to these will form the basis of the study.

Identification

(M. I. Brand) (CONFIDENTIAL)

During this biweekly period the following proposals were submitted to D. R. Israel:

a. A revised proposal for the evaluation of the Identification Section of the Cape Cod System.

b. A proposal for the elimination of log keeping in the Cape Cod System by use of magnetic-tape storage and subsequent analysis and print-out of pertinent data.

c. A proposal for an additional display for the Identification Officer which would provide for him upon demand a history and DID of any selected flight plan.

During this period the identification memo M-2580, "Description of the Identification Function of the Cape Cod System," was completed and approved. It will be published within a few days. Another ID memo is now

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1.14 Weapons Direction (Continued)

(M. I. Brand) (Continued) (CONFIDENTIAL)

being written in conjunction with S. J. Hauser. This will be an instructional memo explaining the operational procedures of each job in the Identification Section.

(J. J. Cahill Jr.) (CONFIDENTIAL)

A visit was made to Truro on 30 December to inspect the arrangement of the console for the TPS-10D height finder. It was noted that the slewing control was not located at the range-height console but rather at an associated PPI console. This is not in accordance with best practice for height finding under control of the computer. Plans for remating the control to the RHI console were discussed with L. C. Wilber of Group 22, who was present at the site. After confirming the arrangements with other Group 22 people, the modification will be performed. The radar should be ready for use in about two weeks.

While at Truro, advantage was taken of the opportunity to discuss Air Defense Direction Center practice with Capt. Will, Operations Officer of the 762nd AC&W Squadron. Information was obtained which may prove useful during the forthcoming Air Defense Command visits.

At the request of D. R. Israel, a study has been made of the merits of azimuth sequencing in height finding under control of the computer. Results will be available in a day or two, in the form of an inter-office memo to D. R. Israel. Briefly, it might be said that since the computer must be time-shared by height finding and other defense functions, it is not practical to operate the height-finding program often enough, per frame, to take advantage of the relatively insignificant time saving gained by azimuth sequencing.

A proposal for evaluating the AA-guidance features of the 1953 Cape Cod program has been submitted. A proposal for evaluating height-finding features was prepared by C. Grandy, with assistance from the writer.

(F. M. Garth) (CONFIDENTIAL)

A flow diagram showing how the principles of command tracking could be used to aid in both interceptor initiation and tracking was prepared and submitted to the TWS Section. Remaining time was spent in Intercept Direction evaluation and in attempting a minimum-fuel return-to-base program which would reconcile existing flight-characteristics information with the present Cape Cod System.

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1.14 Weapons Direction (Continued)

(C. Grandy) (CONFIDENTIAL)

A preliminary proposal for the evaluation of the Cape Cod height-finding section has been made. This is presently under study and revision. Actual evaluation will begin during the coming biweekly period. The editing of M. A. Geraghty's memorandum M-2588, "Determination of Altitude and Raid Size in the 1953 Cape Cod System," was completed in conjunction with G. A. Rawling, and the memo will be issued early in the next period. A visit was made to the Lincoln installations at North and South Truro to inspect and become familiar with the height-finding facilities at these locations.

Also visited was the 762nd AC&W group at North Truro. The purpose of this visit was to observe the operations of the GCI station and to become acquainted with the organization of same. This is background information for the coming visits by ADC personnel. Schedules for the first group of these visitors have been made, and arrangements are being completed. This visitation will require considerable time and attention during the next 30 days.

(S. J. Hauser) (CONFIDENTIAL)

A study of the summary logs on flight tests was made and judged to be inadequate for making an evaluation of the identification system as outlined in a proposal by M. Brand. Separate log sheets have been prepared to make this evaluation and will be summarized in future scheduled tests.

A study of the operation procedures of stations outside the Direction Center, but relating to data input, is in progress and will contribute to a memo on standard operating procedures.

(F. E. Heart) (CONFIDENTIAL)

Most of the past biweekly period was spent considering various proposed logical changes in the Cape Cod System.

Efforts to complete Cape Cod order analysis by automatic methods have continued sporadically, as time permits.

A small file of bibliography cards is now in existence; this file is a highly filtered version of several sets of Library accessions lists. It is expected to become available to interested persons during the next two weeks.

(W. Z. Lemnios) (CONFIDENTIAL)

Forms have been prepared to take data for the evaluation of the intercept team. The evaluation will consist of two parts. First the

1.14 Weapons Direction (Continued)

(W. Z. Lemnios) (Continued) (CONFIDENTIAL)

reliability of the calculations will be observed, and second the efficiency of the intercept team will be noted.

The memo which was being written to explain the climb characteristics of interceptors now in use will be expanded to include all the mathematical approximations used by the Cape Cod System intercept calculations.

No work was done on the return-to-base problem in the past two weeks.

(C. Gaudette, S. C. Knapp) (CONFIDENTIAL)

Work continues on the memo describing the weapons-control function.

In order to evaluate the Cape Cod System, it has been decided that flight tests will be run in which many of the tracks will be simulated. W. Lone's FTU program has the facility for simulating radar data for such tracks while real radar data is also being used. We are now planning the first of these tests and making up flight plans for the simulated tracks. The actions of the FTU, such as activating the tracks, turning them, etc., are being written in detail on cards to be referred to during the test.

(L. Murray) (CONFIDENTIAL)

Many difficulties were encountered during the D/L (data link) tests conducted during the last two weeks. The transmitting facilities have not been all that they should be, and aircraft receivers have not operated as expected. As a result, a more rigorous test procedure has been established, and five tests a week will be conducted in January, weather permitting. These tests will use mechanical-generator messages. From the results of these, a new D/L control program will be written and tested. Progress reports of the tests will be written weekly as inter-office memos.

A standard operational procedure is being established for the Radio Operator position of the Cape Cod System. This will be discussed with ADC representatives during the next biweekly period.

(J. Nolan) (CONFIDENTIAL)

The time during this biweekly period was spent preparing a proposal for evaluation of the Weapons Assignment and Direction station and rewriting the memo on operating procedures for this station.

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1.14 Weapons Direction (Continued)

(C. A. Zraket) (CONFIDENTIAL)

The activities of the Cape Cod Direction Center were curtailed during the past biweekly period due to an agreement with the Air Force not to run any large-scale live tests. Two training missions for the operating personnel were conducted using both recorded and simulated data. The majority of the scheduled calibration checks on the radar sets were cancelled due to bad weather and aircraft unavailability. One calibration mission was aborted due to a computer power failure when both a B-29 with a bombsight and the radars were available. A successful calibration and tracking mission using Mark X data from an F-89 was conducted on 30 December.

The automatic ground/air data-link test program is continuing in conjunction with Group 22. A daily test is scheduled during the months of January and February which will be monitored at Hanscom Field by the Group 22 ground unit and at the Whirlwind site. The data link will not be used operationally in Cape Cod tests until it has proven reliable in the foregoing series of tests.

The organization of the evaluation program for the Weapons Direction Section of the Cape Cod System was effected during the past biweekly period, and a series of evaluation tests will commence after the first of the year. Each of the Group 61 evaluators for the individual stations in the Cape Cod Center has written a proposal describing the aims and methods of obtaining results for the evaluation of his particular station. An inter-office memo has been written to C. R. Wieser and D. R. Israel describing the evaluation program in general.

A rough draft of a memorandum has been written in conjunction with W. S. Attridge describing the temporary procedures to be used by operating personnel for the initiation, tracking, and control of interceptor aircraft in the Cape Cod System. These standard operating procedures will serve to coordinate the liaison that must be maintained between Track-While-Scan and Weapons Direction in order to effectively track interceptor aircraft with the present Cape Cod program. It is hoped that this stop-gap measure will alleviate the current trouble with interceptor tracking until such time as the program can be modified to include additional displays and until Mark X data on interceptors is available.

Memos concerning standard operating procedures for the Weapons Director, Intercept Directors, Radio Operators, and aircraft pilots are currently in preparation.

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SECURITY INFORMATION

1.15 Direction Center Operations

(P.O. Cioffi) (CONFIDENTIAL)

The following table summarizes the flight-test activity for the past period. Scheduling has favored testing of auxiliary and associated equipment for systems operation. Full-scale operations are planned for the next period under the plan of two tests per week including the usual demonstration.

The new set of Direction Center operations-data record forms was completed and accepted for use. All the records of the previous tests have now been examined and summarized using these new forms. As was expected, these previous records were rather haphazard and innaccurate in many cases, so much so that any analysis of systems operation will not be based on this data.

I have continued getting together information for the design of a set of rules regulating the defense of the Cape Cod area on which to base an analysis of the systems operation. Planning for setting up such a defense sector has been speeded up in order to provide for operations early next year some sound basis on which to measure the defense-system performance. Meetings with operational personnel are planned for the immediate future to issue instructions for the proper handling and recording of data prior to air-defense operations.

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1.15 Direction Center Operations (Continued)

(A.P. Hill.) (CONFIDENTIAL)

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DATE	TIME	A/C	SCHEDULED TEST Description	A/C	TEST ACTUALLY RUN Description	REASONS FOR CHANGES OR COMMENT
12/18	1300-1600	1	Calibration	1	As Scheduled	
12/22	1400-1600	2	Calibration and Data Link	1	Held Calibration, cancelled Data Link	Data Link ground equipment inoperative
12/23	1300-1500	1	Calibration of Mark X	-	Cancelled	Mark X ground equipment inoperative
12/29	1000-1200	2	Data Link Check	1	Held with 1 F-89 from 1300-1500	Cancelled other F-89 due to weather
	1300-1500	1	Calibration	-	Cancelled	B-29 with bombsight not available
12/30	1000-1200	2	Data Link Check	-	Cancelled	Data Link ground equipment inoperative
	1300-1400	1	Mark X	1	As Scheduled	
	1300-1500	1	Calibration	-	Cancelled	Computer inoperative

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* Added to Schedule during week of test

1.15 Direction Center Operations (Continued)

(E. Cottier) (CONFIDENTIAL)

Computer Operation:

Total Assigned Time	52.5 hr
Weapons Control	0
TWS	29 hr 05 min
Combined	
Weapons Control	13 hr
TWS	2 hr 25 min
Tracking and Control	
Total	44 hr 30 min
Time to Math Group	2 hr 50 min
Time to In-Out	1 hr 45 min
Lost to Computer	3 hr 25 min
Total	8 hr
	44 hr 30 min
	8 hr
Grand Total	52 hr 30 min

(E.W. Wolf) (CONFIDENTIAL)

There were only 8 hours of Cape Cod System operations during the past biweekly period. This is not enough to make a statistical breakdown of the equipment-reliability reports significant. These reports will be included in the summary for the next period.

It should be pointed out at this time that the analyses of equipment reliability reported thus far have not included a comprehensive account of the quality of the radar data as they become available for processing in their final form. The following are some of the reasons why it has been difficult to give such an account:

1. It is not easy to determine the source or cause of the trouble; it may be at the radar site, in the transmission system, in the mapper or MITE units, or in the computer proper.
2. The trouble is usually sporadic in nature; it lasts for a few seconds or a few scans and then disappears or is

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1.15 Direction Center Operations (Continued)

(E.W. Wolf) (CONFIDENTIAL) (Continued)

repaired by maintenance personnel. A sampling of some of these troubles, as reported by the Mapping Room personnel, is included here for illustrative purposes:

- a. 1° stroke every sweep for 5 minutes
 - b. Complete coverage of noise for 5 sweeps
 - c. Calibration circle painting
 - d. All data jumping 180° every sweep
 - e. All data cut out for 2 minutes
 - f. Extra North marker every sweep
 - g. Heavy noise for one sweep
 - h. North marker and data jumped 180° for one sweep
 - i. Data suggests that the MTI was removed
 - j. Intermittent lines of interference, 045° and 330°
 - k. North marker intermittent
 - l. Data not consistent, paints every third sweep
 - m. Heavy intermittent noise for two sweeps.
3. Sometimes trouble may exist without anyone realizing that the equipment is at fault. This may occur when returns from some or all aircraft are not received consistently, or when only odd-numbered or only even-numbered range returns are received.

An attempt will be made to pay more attention to these matters in the future.

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1.16 AN/FSQ-7 XD-1 Support

(D.R. Israel) (CONFIDENTIAL)

The changes recommended in M-2572, "XD-1 Order Code" (D.R. Israel), have been accepted by IBM.

A large part of the past two weeks has been devoted to preparation of a floor plan for the operations area on the 2nd floor of the XD-1 building. A plan based on presently known operational considerations was prepared in conjunction with C. Grandy and was submitted and accepted on 30 December. This plan, including a partition layout, is given in print D-57427, "AN/FSQ-7 XD-1 Building, Revised Plan." This layout differs from previous proposals in that a better utilization of corridor space is obtained and that both the TWS and Weapons Direction areas are close to the head of the stairs leading to the computer operating console on the 1st floor. It has been agreed that with this arrangement, there will be no requirement for duplicating the facilities of the operating console on the 2nd floor.

Personnel requirements of the proposed AN/FSQ-7 Direction Centers and Combat Centers were reviewed on 31 December with Rader, Churchill, Boehmer, Wieser, and Walquist. The revised personnel estimates, which differ only slightly from those in M-2409-1, will be the subject of a meeting with ADC and ADES in Colorado Springs during the week of 4 January. A memo supplementing M-2409-1 will be issued as soon as possible.

A number of hitherto unanswered questions relating to the organization and operation of the AN/FSQ-7 Direction and Combat Centers have been prepared. The questions are chiefly concerned with problems of the delegation of functions and responsibilities among personnel, between sub-sectors, and between Direction Centers and Combat Centers. The answers to the questions will have a small effect on the floor plans, number and type of personnel, or on the equipment requirements, with the exception of the intercomm system. The questions were recently reviewed with C.R. Wieser and will be discussed in detail with the ADC controllers during the next few weeks (see Section 1.14). A memo covering the material of the questions is in preparation.

Further consideration has been given to the type of intercomm system necessary in the XD-1 installation. The problem becomes extremely more difficult than that of the Cape Cod System because of the multiplicity of Intercept Direction (IND), Tracking Initiator (TI), and Track Monitor (TM) positions. Furthermore, the requirement that the system operate efficiently under non-full-load conditions with a reduced number of operating positions creates a multitude of problems. The as-yet-undetermined organization and utilization of Intercept Directors and Weapons Directors also makes specification of the system difficult. At present, considerable thought is being given to the advantages and disadvantages of a dial system.

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1.16 AN/FSQ-7 XD-1 Support (Continued)

(H.D. Benington) (CONFIDENTIAL)

A meeting was held with Harris and Greene of Group 38 on MTC simulation of XD-1 displays. A definite proposal will be presented soon.

The proposed display system was discussed with IBM; agreement has been reached on all points except off-centering and expansion. This should be settled during the next biweekly period.

(C. Grandy) (CONFIDENTIAL)

The room layout for the XD-1 building was considered at length in conjunction with D.R. Israel. An informal proposal has been submitted to Division 7 (B. Ahern) for their consideration. If approved by them, the floor plan will be submitted through formal approval channels and the layout frozen. Final action on this is expected early in the next biweekly period.

Work on considerations affecting the XD-1 console design has been somewhat neglected due to higher priority tasks. A renewed effort to assemble a comprehensive tabulation of personnel, consoles, and equipments will be made in the coming period. The deadline for this design is rapidly approaching.

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Memorandum M-2596

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1.2 Group 64

(S. H. Dodd) (UNCLASSIFIED)

Operation of the computer has been good during the past biweekly period. The only major trouble encountered was the result of a tube failure which damaged several crystals in one of the core-memory matrices.

The ERA photoelectric tape reader has been replaced with one made by Ferranti. This new reader is capable of operating in a line-by-line manner. However, it has been recommended that programmers do not depend upon line-by-line operation until further investigation of the problem of clutch wear has been completed.

1.21 WWI Systems Operation

(S. E. Desjardins) (UNCLASSIFIED)

The consolidated test program has been rewritten to include the drum-check programs and will be tested as soon as the tape is made up. The completed tape will then contain seven of the eight test programs which are used daily and will expedite marginal checking tremendously.

(D. A. Morrison) (UNCLASSIFIED)

The mechanical design of the proposed voltage interlock panel has been firmed. Sketches will be ready for production by 5 January 1954. Installation of the panel in WWI is predicted for early in February.

Core Memory

(N. L. Daggett) (UNCLASSIFIED)

Six hours of computer time were lost last week because of damage to one of the selection matrices for the core memory. Twelve crystals were ruined by a dead short which occurred in one of the driving cathode follower tubes. Part of the time was lost through attempts to find the bad crystals by a logical process based on voltage readings of the selected and deselected lines. This method appeared to be unworkable because of the multiple failures; therefore, the brute-force approach was used. Each output line was measured for the back resistance of its five associated crystals. Each bad group was opened up to determine which of the five crystals was bad.

We will attempt to make changes to prevent repetition of this type of failure. The problem is not a simple one, however. It is aggravated by two things: (1) The matrices are not operated at ground

1.21 WWI Systems Operation (Continued)

Core Memory

(N. L. Daggett) (Continued) (UNCLASSIFIED)

level. (2) They are driven by cathode followers rather than plate-loaded stages. This means that failure of cathode-follower plate voltage can cause serious trouble.

(L. L. Holmes, A. J. Roberts) (UNCLASSIFIED)

Four d-c coupled parity registers have now been installed in the system. Two more will be installed on 2 January.

A modification is in progress to provide separate post-write disturb pulses for each bank of storage. At present post-write disturb is applied to both banks on each storage cycle regardless of which bank is selected. The change should allow more time for the sense amplifiers to recover.

Magnetic Tape

(E. P. Farnsworth) (UNCLASSIFIED)

The new shipment of MMM mylar-base tape has arrived and is being used to replace all acetate and old, spliced, worn, and wrinkled mylar. No splices have been found so far in the new shipment.

Dynamic torque unbalance in one servo amplifier has been traced to the mercury-vibrator servo-discriminator relay. These Western Electric relays are conservatively rated at one billion operations, which is approximately the number of operations in service to date. The exact nature of the defect causing unbalance and the normal operating conditions of the Raytheon circuit are being studied.

The final thyratron register panel for delayed print-out was installed and several wiring errors corrected. This panel was modified to include series-dropping resistors in the punch circuit to reduce heating of the solenoids. This change was suggested by Norcott and is now recommended by the manufacturer for all Flexowriter punch circuits.

Typewriter and Paper Tape

(L. H. Norcott) (UNCLASSIFIED)

A panel has been installed on the Flexowriter table to permit the operator to control the direct-output punch from the keyboard of the direct-output Flexowriter.

1.22 Terminal Equipment

(R. H. Gould) (CONFIDENTIAL)

A variac has been installed on the site-status map to control the brilliance of the status lights. An ultraviolet fluorescent light has been installed to illuminate the map, but it is unnecessarily powerful. It will be replaced with a smaller light when time permits. The control box for the status lights has been fastened near the map. The information on the sites comes into Room 224, but it seems unwise to put the control switch where the map cannot be seen. Comments on the map are invited.

The wiring for the power to the illuminated map shelves has been delayed by the loss of a Saturday and an installation Monday. It is hoped that several shelves will be powered within a week. Black and white paints properly applied will make the shelves effective. The electric clocks at the display consoles in Room 222 will be wired directly to the internal terminal strip and will all be controlled by a switch at Station P, the Flight Test Umpire.

The yellow curved Plexiglas shields that will replace the curved colorless shields and the orange cellophane on the 16-inch display scopes are being beveled to fit.

A sixth position providing expansion without off-centering has been added to the 16-inch display-expand and off-center control switch at Stations G11 and G14. The expansion factor was set to 1.5 instead of 1.414 which was the maximum allowable without the nonoff-centered expansion.

Controls for expansion about two arbitrary points are being built for the 16-inch display scopes at F11 and F12.

Marginal Checking

(S. Ginsburg) (UNCLASSIFIED)

The work on marginal checking the Cape Cod System has been temporarily halted in favor of the CRT filter system.

Several types of one-shot multivibrators were designed and are being breadboard tested. The basic circuits for the filter system are presently being designed with the intention of finally having the system completely packaged in plug-in units. The circuits will initially be tested with a video mapper.

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1.22 Terminal Equipment (Continued)

Magnetic Drums

(K. E. McVicar) (UNCLASSIFIED)

We have increased the writing current on the auxiliary drum in an attempt to reduce the effects of writing between the slots. This change seems to have been of some value, but we have not had enough experience yet to draw any definite conclusions.

Preliminary investigation of the relation between write-pulse width and definition of the read-back signal indicates that we can safely increase the write-pulse width by a large factor. A wider write pulse should further reduce sensitivity of the system to between-the-slots writing.

PETR

(F. E. Irish) (UNCLASSIFIED)

A Ferranti photoelectric tape reader has been installed as a replacement for the ERA reader. All of the tapes used with the ERA reader should read in using the new reader without any trouble. The new reader is initiated on a si 211 order and is stopped on the clearing of the IOS, after an alarm, or after a "switch to push button" (stop).

The new reader is able to stop the motion of the tape in about 1 millisecond. This means that if the stop is ordered immediately following the last rd order the tape will stop with the last character to be sensed still resting on the sensing holes. Eventually, this ability to stop rapidly will permit the fences used at present in Flexowriter tapes to be eliminated. Until further experience is gained; however, programmers should not depend on the reader stopping any faster than did the ERA reader.

When the new reader is stopped by some method that does not change the IOS, program alarms will be generated if the tape is then manually moved. The generation of program alarms signifies that extra information has been put into the IOR.

1.23 Records of Operation

(F. J. Eramo) (UNCLASSIFIED)

The following is an estimate by the computer operators of the usable percentage of assigned operation time and the number of computer errors for the period 18 - 30 December 1953:

1.23 Records of Operation (Continued)

Number of assigned hours	105
Usable percentage of assigned time	95
Usable percentage of assigned time since March 1951	86
Number of transient errors	6
Number of steady-state errors	2
Number of intermittent errors	4

Component Failures in WWI

(L. O. Leighton) (UNCLASSIFIED)

The following failures of electrical components have been reported since 18 December 1953:

<u>Components</u>	<u>No. of Failures</u>	<u>Hours of Operation</u>	<u>Reasons for Failure</u>
<u>Capacitors</u>			
0.1-mfd 600-v d-c Sprague Vitamin Q	1	0 - 1000	Shorted
<u>Crystal Rectifiers</u>			
1N38A	1	2000 - 3000	Low R_b
	8	3000 - 4000	Low R_b
<u>Resistors</u>			
22-ohm 1-watt $\pm 10\%$	1	0 - 1000	Overheated
<u>Tubes</u>			
5881	1	1000 - 2000	Low I_b
	1	2000 - 3000	Low I_b
	2	3000 - 4000	Low I_b
5963	1	0 - 1000	Short
	1	3000 - 4000	Low I_b
6AU6	1	3000 - 4000	Short
	1	15000 - 16000	Low I_b
5670	1	9000 - 10000	Short
6BL7	1	0 - 1000	Broken alignment pin
6145	3	3000 - 4000	2-short; 1-leakage
5U4G	1	6000 - 7000	No filament
6080	1	2000 - 3000	Short
6080WA	2	0 - 1000	1-low I_b ; 1-mech. failure
63J	1	19000 - 20000	Broken base

1.23 Records of Operation (Continued)

Component Failures in WWI

(L. O. Leighton) (Continued) (UNCLASSIFIED)

<u>Components</u>	<u>No. of Failures</u>	<u>Hours of Operation</u>	<u>Reasons for Failure</u>
<u>Tubes</u> (Continued)			
6SN7	1	7000 - 8000	Low I_b
7AD7	1	19000 - 20000	Short
	1	20000 - 21000	Short

1.24 General

D-C Power Supplies

(S. T. Coffin) (UNCLASSIFIED)

The rebuilt WWI +150-v, 50-amp d-c supply is being tested and is nearly ready for reinstallation in WWI.

1.3 Group 65

1.31 Activities of Group 65

(P. Youtz) (CONFIDENTIAL)

The work on the helical dag coating for the Charactron tube, which permits a low voltage in the deflection region and a very high voltage at the phosphor screen, was continued during this period with very satisfactory results. An attempt will be made during the next period to put this dag coating on a large TV envelope and to process an envelope with a gun.

Work was done on the design of a 19-inch bulb for the Charactron tube. A trip will be made to Corning Glass Works 14 January, 1954 to discuss the 19-inch bulb requirements with Corning engineers.

Work to support the program of Group 25 was continued.

C. L. Corderman and I will visit Convair on 4, 5, and 6 January to discuss the technical specifications of the 19-inch Charactron. On 7 and 8 January, Frank Rodgers (Group 25), C. L. Corderman, and I will visit Hughes Aircraft to discuss the progress and status of the Typotron project.

The tube group will visit GE at Owensboro on 11 and 12 January to discuss the progress and status of the Z-2177 (improved 5965) tube program.

On 13 January, John Geisler, of the IBM Tube Analysis Lab, and I will visit Western Electric at Allentown to discuss the 5998 tube.

1.33 Research and Development

(J. S. Palermo) (UNCLASSIFIED)

Series of spiral dag experiments have been successfully completed. It has now been established that continuous spiral lines of specified lengths can be coated on glass with the resistance of less than 1 megohm per inch after bakeout.

New techniques for coating with helical ink and modified formulae will be tried during this next period. Coatings with chromic oxide have been successful. Bakeout schedules for these coatings have also been established.

Various experiments are being conducted for Group 25.

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SECTION II - AN/FSQ-7

2.1 Group 62

2.11 Systems

Circuit Application Section (MRD Book)

(R. Callahan, A. Heineck) (UNCLASSIFIED)

M-2585-1 has been written and describes the information needed for final approval of circuits. It discusses in detail the information that should be contained in the MRD report and also the supporting margin or reliability data necessary for final approval.

To differentiate among the three cathode followers available for XD-1, it has been tentatively decided to label the 5965 cathode follower as the small cathode follower, the 7AK7 follower as the medium cathode follower, and the 5998 follower as the power cathode follower.

Delay-Line Adder

(R. Callahan, A. Heineck) (UNCLASSIFIED)

The adder has been running for the past biweekly period. Preliminary investigations indicated that many of the pulses generated by the test equipment were low in amplitude (less than 20 volts), and pulse amplifiers are being added. Because of this, no margins have been taken on the adder.

Some trouble has occurred with open wiring on the etched cards. Out of 19 cards, 4 have been found with open etched lines. It should be noted that both the card material and width of the etched lines are different from that proposed for XD-1.

Marginal Checking (XD-1)

(R. J. Pfaff) (UNCLASSIFIED)

A marginal-checking breakdown for the central computer, with the exception of memory, has been completed. Some of the rough edges have yet to be smoothed out as final drawings become available. Two reports to explain and justify the breakdown chosen are under way.

2.12 Magnetic-Core Memories

Miscellany

(W. Papian) (UNCLASSIFIED)

Results of early testing on the 64 x 64 memory for MTC look good. Two weeks of testing, modifying, and adjusting should suffice; the memory should be ready for installation in MTC by 12 January.

A serious outage occurred on the WWI Core Memory; ten diodes in one of the coordinate-selection matrices were ruined as a result of what appears to have been a shorted 645 vacuum tube in the matrix-driver circuits. Precautions are being taken to protect the diodes in the 64 x 64 memory from a similar accident.

Work is in progress at IBM to prepare the first section of the XD-1 memory design for approvals which will lead to releases for construction. We would like to release the entire "shower stall" as soon as possible.

64 x 64 Memory

(E. A. Guditz) (UNCLASSIFIED)

Tests have been made on a 64 x 64 memory plane (C1), and the results are very satisfactory. The core outputs are very uniform and the ONE-ZERO ratio appears to be as good or better than that obtained from the 32 x 32 memory planes.

Tests are now being made on the completed memory of 19 planes. Again, tests on C1 are very satisfactory and initial tests indicate that 17 of the 19 planes will be acceptable. Two of the planes have cores which are seriously reducing the ONE-ZERO ratio. Plane C7 has one low-output core, and C13 has 3 low-output cores.

Data taking on the new memory in Memory Test Setup VI will continue through the next week or two.

Mod. II Sensing Amplifier

(W. J. Canty) (UNCLASSIFIED)

This amplifier has shown certain malfunctions when attached to a 64 x 64 magnetic-core memory array. The source of trouble in these amplifiers will be investigated as soon as time permits. The search for a new-type sense amplifier is under way. It is hoped that a less complicated but yet reliable circuit design can be found.

2.12 Magnetic-Core Memories (Continued)

IBM Trip

(W. J. Canty) (UNCLASSIFIED)

Monday and Tuesday of this week were spent at IBM at XD-1 Memory conferences.

Switch Cores

(A. D. Hughes) (UNCLASSIFIED)

Determination of the switch cores to be used for the 64-position "Olsen" switch, as the first step of my thesis, is under way. Since a Mo-Permalloy metallic core has been chosen, the geometry is the only variable. I am working with something very close to the desired core ($\frac{1}{4}$ -mil, $\frac{1}{4}$ -inch, 140-wraps). Also, the number of turns has been worked out ($N_1 = 10$ turns, $N_2 = 6$ turns).

Work with cores of several sizes (on a single-core basis) will continue.

2.13 Vacuum-Tube Circuits

Summary

(R. L. Best) (UNCLASSIFIED)

A joint IBM-MIT meeting at High Street resulted in a decision to have IBM concentrate on a magnetic read-write switch for the drums, and to have MIT concentrate on a diode switch. MIT's switch is to be installed in MTC. It is planned to have the switch evaluated by 1 February.

Remis is in Poughkeepsie working with Beasley of IBM in writing some final reports on cathode followers and diode-circuit design. He is also reviewing the instruction-frame circuits, in particular the cathode follower and diode design thereof.

Magnetic Drum

(H. Anderson, H. Boyd) (UNCLASSIFIED)

Samples of different kinds of high-impedance heads will be received from Endicott. From these samples a type of head will be selected for the MTC installation.

The circuits associated with the read-write switch for the MTC installation are being designed.

Magnetic Drum Write Circuits

(S. Bradspies) (UNCLASSIFIED)

Work has begun on designing a circuit which will be driven by a low-speed flip-flop and which will give outputs of 150 volts or some voltage as yet undetermined. The output voltage will drive the grid of a cathode follower, which determines the field selected for writing.

Selection-Plane Driver XD-1

(D. Shansky) (UNCLASSIFIED)

Some time has been spent in reviewing the proposed design of the XD-1 memory selection-plane driver. Some modifications have been suggested, and these are being breadboarded.

2.13 Vacuum-Tube Circuits (Continued)

Core Driver Mod. VII

(D. Shansky) (UNCLASSIFIED)

The negative half of this driver prototype has been debugged and delivered to Group 63 for further test.

Digit Plane Driver "Post Write Disturb" and "Inhibit" Gate Generator, MTC

(D. Shansky) (UNCLASSIFIED)

These circuits are presently being designed.

High-Speed Flip-Flop

(C. A. Laspina) (UNCLASSIFIED)

Investigation of various input circuits for the HSFF is still going on.

An arrangement using a parallel RC circuit in series with the primary of the input transformer was tried. The performance of this circuit was not as good as the performance of the circuit using a series diode in the primary.

Delay-Line Circuits

(J. S. Gillette) (UNCLASSIFIED)

I have recently found that when using long delay lines a pulse arrives at the end of the delay line before the main pulse arrives. The exact cause is unknown, and tests are being made to see what the cause is.

Typotron Display

(H. J. Platt) (UNCLASSIFIED)

The construction and assembly of equipment for tying in a Typotron to MTC continues.

A deflection amplifier is under construction. An erase driver is being designed. A storage-tube mount is being modified to hold the Typotron.

2.13 Vacuum-Tube Circuits (Continued)

Pulse Transformers

(E. Gates) (UNCLASSIFIED)

A few tests have been made on the memory planes being driven by pulse transformers. However, not enough is known yet to form any conclusive opinions.

A partial shipment of memory-driving transformers was received from Sprague Electric Co. Electrically the transformers are good, but they need some mechanical improvement.

2.14 Memory Test Computer

General

(W. A. Hosier) (UNCLASSIFIED)

Checking of the newly installed cables in MTC Control was completed just before Christmas; power was turned on for the first time since the shutdown on Monday, 28 December.

Three days debugging has substantially restored operation of all the old instructions retained and has allowed good progress to be made on the new ones (sof and tro) affecting group & field control. The computer should be available for Typotron and Charactron work by about 5 January.

Meanwhile, we have continued with installation and hookup of the 64 x 64 memory equipment, which should be ready about the same time as the memory planes proper.

Also, the ground work has been laid with the Drafting Room for a comprehensive plan to amplify the MTC drawings where necessary and make sure that all are up to date.

Input and Conversion Programs

(P. R. Bagley) (UNCLASSIFIED)

A new 4-6-6 input program for reading in 4-6-6 tape is finished and is published with brief notes as drawing SA-55786-1.

A basic conversion program is being planned. An advance copy of the vocabulary for this program is available as drawing SA-57300. The structure of 4-6-6 tapes which will be produced by the basic conversion program, and which will be read in by the 4-6-6 input program, is illustrated in drawing SA-57298.

2.14 Memory Test Computer (Continued)

(P. R. Bagley) (UNCLASSIFIED) (Continued)

A memorandum (M-2527, Supplement 1) is being written which describes in detail the entire input process, including the preparation of paper tape and the operation of the input and conversion programs.

Performance after Recent Changes (Preliminary Report)

(R. A. Hughes) (UNCLASSIFIED)

All of the old MTC instructions (except tp and np, which were not retained) are now working. The changes have increased speeds: on test program TP-60, which used to have an average instruction time of over 20 microseconds, the average is now 13, or 77,000 instructions per second. (This figure applies when using panel storage but should not be more than 1 or 2 microseconds more even with the magnetic-core memory.)

There is possibility of reducing the average instruction time even further by moving control-switch flip-flops from A-frame to the control frame, thus eliminating some 40 feet of coax transmitting levels, and hence cutting rise times.

Pulse amplitudes can also be improved by staggering certain read-in commands which now occur simultaneously. New loads hung on the A-register "1" bus (drum-address register, drum-write register) have not lengthened HSE time beyond 0.5 microseconds, but when all of these registers are read into simultaneously, peak suppressor current tends to overload A-register cathode followers.

Automatic Memory Display

(J. Crane) (UNCLASSIFIED)

Panels for automatic memory display are being constructed and will be completed during the next biweekly period.

Group and Field Control

(J. Crane) (UNCLASSIFIED)

Group and field control was installed and preliminary checks were made on this unit before making it an integral part of MTC Control. Outputs of diode matrices had rise times of less than 1 microsecond, and the counter in the program field register operated correctly.

2.14 Memory Test Computer (Continued)

Magnetic Drum

(H. Anderson, H. Boyd) (UNCLASSIFIED)

We are trying to have the MTC drum installation in limited operation on or before 1 February 1954, in order to obtain a decision at that time as to what scheme will be used in ID-1. The system to be investigated is one employing a high-impedance head and combined read-write diode switch. Preliminary tests of the head look favorable.

MTC Drawings and Records

(L. Sutro) (UNCLASSIFIED)

Drafting has informed us that the easiest way for them to revise MTC drawings is to rework all of one type of panel at a time. They will start with the eight dual-gate panels, then take flip-flop mounting panels, gate-buffer panels, etc.

MTC Power-Supply Control

(D. M. Fisher) (UNCLASSIFIED)

Conferences continue on the basic logic of the power-supply-control system. Since all the people concerned with the system have not been contacted, the final design is not considered complete.

The proposed system, in its present form, has 23 relay circuits less than the old system. It is felt that the simplicity of this system will not restrict its versatility to cope with unforeseen problems arising in MTC at some future date.

2.15 Equipment Design and Schedules

(W. H. Ayer) (UNCLASSIFIED)

A review of the cooling-equipment system for the XD-1 building has been undertaken in the last three weeks. The basic design parameters have been gone over at some length, particularly the desired percentage humidity. Unfortunately, very little, if any, literature exists on the effects of varying humidities, although a strong body of opinion at both MIT and IBM feels that a range of 50 - 60 per cent should be maintained for utmost reliability of the electronic equipment.

2.15 Equipment Design and Schedules (Continued)

(W. H. Ayer) (UNCLASSIFIED) (Continued)

Details of the air-handling system are now being worked out by Francis Assoc. along with the chilled-water refrigeration system. It is planned to tie in to the CRC central system for standby capacity.

Planning for the XD-1 building is proceeding according to schedule and should be finished by the 1 February 1954 deadline.

(J. D. Bassett) (UNCLASSIFIED)

Considerable attention is being focused upon the printed-circuit fabrication techniques to be used in AN/FSQ-7, as well as the ability of these circuits to withstand vibration and shock to be expected in normal transportation. Details are included in M-2584, a report by B. B. Paine on a meeting held with J. W. Forrester on 23 December 1953.

Methods for plating through holes in printed-circuit cards without the use of silver are being investigated, in order to eliminate the danger of trouble from silver migration in service.

Various coatings for printed cards are being studied and evaluated.

C. W. Watt and I are collecting data from various users of "Epoglas" laminate in order to form a cross section of consumer opinion based on actual experience with this material, which may be used in AN/FSQ-7.

(J. Giordano) (UNCLASSIFIED)

The past 2 weeks have been spent in setting up various administrative procedures for the MIT systems office.

The second construction progress report of XD-1 and XD-2 will appear in the 4 January issue of the Biweekly Progress Report of the AN/FSQ-7.

(P. J. Gray) (UNCLASSIFIED)

Amendment 1 to the AFCRC Exhibit was discussed at a meeting in Poughkeepsie last week. Except for a few minor points, the amendment is ready for preparation in final form. Amendment 1 will be issued 15 January. Amendment 2, which will consist of a new description of the AN/FSQ-7 equipment, will be issued 30 January.

2.15 Equipment Design and Schedules (Continued)

(P. J. Gray) (UNCLASSIFIED)

In connection with the work on the exhibit, IBM has proposed that the interior of all frames, cabinets and consoles will be light eggshell. The exterior of equipment in normal light areas will be standard IBM light gray. The exterior of equipment in darkened areas will be another shade of lighter gray.

IBM is continuing work on detailed time schedules. Preliminary schedules have been turned over to Steve Dodd covering parts of the central machine, mappers, display, and the arithmetic-element model.

2.16 Transistors

(D. J. Eckl) (UNCLASSIFIED)

The control system for the accumulator has been completely changed over to plug-in units. This simplifies the unit considerably and requires less power and space. The accumulator has been in operation for 9300 hours.

The sixth note on the physics of semiconductors is in preparation. This note deals with the properties of holes and electrons.

Flip-Flops and Gates

(E. U. Cohler) (UNCLASSIFIED)

Several types of current flip-flop circuits which were presented in Williams' article (Proc. IEE) were studied and found to be about the same as the voltage flip-flops as far as speed was concerned. The reliability and triggering requirements of these types are somewhat better than the old voltage flip-flops. This is because they are highly stabilized by numerous diodes. The possibility of using these flip-flops with a new type of gate is being investigated.

Transistor Gates

(C. T. Kirk) (UNCLASSIFIED)

As mentioned in the previous biweekly $V_{c_{34}}$ has been found to be an important parameter in determining whether a particular transistor will function in the gate circuit. Further investigation of this fact has shown that there is some correlation between $V_{c_{34}}$ and frequency response of a point-contact transistor. Of ten transistors, those with a low $V_{c_{34}}$ were found to have a high frequency response and would function in the gate circuit, while those with relatively high $V_{c_{34}}$ had a poor frequency response and would not operate in the gate circuit.

2.16 Transistors (Continued)

Transistor Magnetic-Core Drivers

(S. Oken) (UNCLASSIFIED)

The point-contact-type core driver has now been running for about 800 hours with no adverse effect on the transistor characteristics.

A junction-type core driver has been developed which consists of Williams -type single-transistor flip-flop driving a grounded-emitter junction-transistor stage. In order to overcome the slow rise time of the junction transistor this output stage is driven into saturation. This also stabilizes the output current except for variations in Vcc. A test setup for using this core driver to drive several cores in series is being built.

The feasibility of using a point-contact-type transistor amplifier in the active region will be investigated. Some method for cooling the transistors will have to be found.

2.17 Display

(C. L. Corderman) (CONFIDENTIAL)

Discussions have been held at the Vestal Labs concerning preliminary specifications for the 19-inch Charactrons. Further additions were made in a meeting at MIT on 30 December.

A revised matrix layout has been sent to Convair. It is quite probable that identical matrices will be used in both 5-inch and 19-inch Charactron tubes.

The week of 4 January will be spent at Convair and Hughes Aircraft Co.

(R. von Buelow) (UNCLASSIFIED)

Entire period was spent in preparing specification for the display system. During the period a meeting was held between IBM and MIT display sections to draw up an outline of these specifications. This will be available as either an IBM or MIT memorandum during the week of 4 January.

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2.17 Display (Continued)

(M. Epstein) (CONFIDENTIAL)

The digital-information-display specifications are being written up. A report by Orin Conant on the DID system is undergoing final revision and should be published the beginning of the next biweekly period. These reports are almost completely in agreement, and formal agreement should be reached soon.

More work was done on the selection equipment for digital displays with special attention paid to see how the selection would be done at the main display frame.

(R. H. Gerhardt) (CONFIDENTIAL)

A block diagram of a part of the display-selection unit (SC-47052) was made. This diagram uses pulse logic. The Harper gate (biased diode) was used wherever possible. Some time was also spent examining some IBM diagrams on the same subject. A joint MIT-IBM display was held to discuss the specifications of the display system. Some time was spent writing the expansion and off-centering portions of the specifications.

(J. Woolf, H. Zieman) (CONFIDENTIAL)

A new idea is being investigated in the design of a vector generator. It is planned to generate the vector as a Lissajous pattern of half sine waves. A full sine wave will be generated at some rate in the vicinity of 1 megacycle and applied to a decoder in such a manner that the decoder output will be a full sine wave of an amplitude determined by the digits set up in the decoder. This sine wave will be transmitted to the console where it will be rectified to a half sine wave before being applied to the deflection amplifier.

The X-Y decoder which is to be included in each console is being further refined and tested in preparation for a final design.

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2.2 Group 63 (Magnetic Materials)

Thermometric Equipment

(N. Menyuk) (UNCLASSIFIED)

Equipment is being designed which will permit the determination of various magnetic and electrical properties of ferrites as functions of temperature over a range from -200 C to 1200 C.

Mn₃O₄-Fe₃O₄ System

(J. B. Goodenough, A. L. Loeb) (UNCLASSIFIED)

Ionic and covalent models have been proposed and compared for the Fe₃O₄ and Mn₃O₄ systems. It looks as though the concept of covalence and covalent exchange can explain the various physical properties of this system.

Memory Digits for a Linear Selection Scheme

(P. K. Baltzer) (UNCLASSIFIED)

Data has been taken on three types of digits for use in a linear-selection memory scheme. Single-core, two-core and three-dimensional digits of General Ceramics MF-1326-B and also single- and two-core digits of MF-1312 have been investigated. The single-core digit is practically the same as for a coincident-current memory except that 3:1 write and register read extend the operating range for the excitation beyond that for the presently used scheme. The two-core digit has a polarity distinction between ZERO and ONE outputs which extends the operating range for excitation to extremely low values, satisfactory operation being obtained for 200-ma register write excitation and 100-ma digit excitation. Integration of the output of a two-core digit made operation relatively independent of strobe time. Thus the upper range of the register drive was almost doubled. (This allowed the digit to be operated between 100 to 2000 milliamperes on register write excitation and between 3 to 650 milliamperes on the digit excitation.) All of the above data pertains to material MF-1312 and is normalized for die F-394. Operation of the three-dimensional digit is very similar to the two-core digit. MF-1312 is superior to MF-1326-B for this application because of its low coercivity and low switching coefficient. A memo is being prepared on the above subject.

Pilot-Plant Production of F-394 Cores

(R. A. Maglio) (UNCLASSIFIED)

Test data has been obtained for DCL-3-70 cores which were fired for the purpose of evaluation of large-batch firing within the Harper Furnace. The electrical test data is for unfired cores, and for each of the electrical properties measured there is no significant change. These cores have been refired; however, test data is not complete on the refired cores.

2.2 Group 63 (Continued)

Synthesis of Ferrites

(F. S. Maddocks) (UNCLASSIFIED)

A sample of a ferrite of unknown composition made by Bell Laboratories has been qualitatively analyzed and found to be a manganese-magnesium ferrite. Quantitative analysis is now in progress.

(J. J. Sacco) (UNCLASSIFIED)

Processing has been started on a new $\text{MgO.MnO.Fe}_2\text{O}_3$ series. The electrical data of these batches will serve as a check on the squareness contour diagram.

At the same time, series of three new systems are being prepared. Cores from a $\text{NiO.MgO.Fe}_2\text{O}_3$ series have been fired and are now being tested, while lithium-manganese Fe_2O_3 and lithium-zinc Fe_2O_3 series are nearing completion.

Ferroxcube Cores

(P. Fergus) (UNCLASSIFIED)

Ferroxcube cores were received and were tested on the B-H loop. Results indicated good squareness (0.84). Pulse tests were made at currents of 740, 820, and 900 milliamperes. These values were within the limits of the specifications, and an evaluation of the lot will be made.

Core Drivers

(J. D. Childress) (UNCLASSIFIED)

The Model VII core driver was delivered this week and will be evaluated for our use.

Life Tests

(J. D. Childress) (UNCLASSIFIED)

Testing has been started on cores to be life tested at elevated temperatures. A study will be made of the effects of temperature cycling of cores, then of switching cores at a temperature around the Curie point. Both RCA and General Ceramics cores will be tested.

2.2 Group 63 (Continued)

Production Testing

(E. J. Stevens) (UNCLASSIFIED)

A second semiautomatic core tester has been put into operation.

Trouble has been encountered in the automatic tester, due mainly to faulty contacts and cam alignment.

In the core testing for XD-1, Lot D-28 has been completed. Lots G-17 and F-99 are nearing completion and will be ready in a few days. The RCA lot XF-345 has also been tested for uniformity.

Stepping-Register Magnetic Cores

(J. R. Freeman) (UNCLASSIFIED)

Magnetics Inc.'s Mo-Perm cores were tested for selection for use in a special coincident-current write, stepping-register output device. Three tests were performed: (1) Cores were selected for a ± 10 percent uniformity of the peaking time of the disturbed-ONE output with a drive of 200 ma. The yield was approximately 65 percent. (2) All cores which passed test No. 1 were tested for ± 10 percent uniformity of peak voltage output using 700-ma READ pulses and 160-ma WRITE pulses. 139 cores passed tests Nos. 1 and 2. (3) Test No. 2 was repeated using 80-ma WRITE pulses, and all cores having outputs greater than 95 millivolts were rejected. Test No. 2 insures uniform ONE read-outs for the stepping register; test No. 3 insures sufficiently small ZERO read-outs for the stepping register.

Ferrite Switch Cores

(J. R. Freeman) (UNCLASSIFIED)

658 MF-1312, F-262 ferrite cores were tested for selection for use in a magnetic-matrix switch. Cores were selected for strength of switch and uniformity of response to a shaped driving pulse of 4 amperes. Acceptable cores were selected for having outputs greater than 1.1 volt over a specified interval of 2 microseconds. 295 cores were selected. 138 additional cores were also selected for outputs between 1.1 and 1.0 volts. 84 cores were rejected for lack of sustained outputs, 20 cores were rejected for slow response, and 121 cores were rejected for completely unsatisfactory pulse response.

SECTION III - CENTRAL SERVICES

3.1 Publications

Requests for Reprints

(J. B. Bennett) (UNCLASSIFIED)

To facilitate requests to outside agencies or publications for published articles, form postal cards may be secured from the 6 library for this purpose.

3.2 Purchasing and Stock

(H. B. Morley) (UNCLASSIFIED)

Purchase orders and catalog files are again so crowded that arrangements are being made to gradually change over to 5-drawer cabinets in place of the present 4-drawer units. All filed material older than 1950 is now in basement storage.

Other changes such as telephone transfers and desk rearrangements are being made to enable us to make better use of our facilities.

The Division 6-DDL stock-renumbering problem is still being actively examined in an effort to find the most feasible way of effecting the change.

The broad capital and non-capital stock inventory recently prepared is being minutely re-examined in an effort to approach a 100-percent accurate count of material and location.

This department has been plagued by the disappearance of many catalogs. This lack hinders the work not only of this department but also of engineering and drafting people who need them for important references. It is imperative that if any persons have catalogs which have been borrowed these catalogs be returned immediately, and none should be removed from Purchasing unless signed out.

Month of December

Total Orders Received 470

Received on time	149	32%
Received 1-7 days overdue	170	36%
Received 8-14 days overdue	60	13%
Received 15-22 days overdue	30	6%
Received 23-30 days overdue	23	5%
Received 1-2 months overdue	21	4%
Received 2-3 months overdue	9	2%
Received 3 or more months overdue	8	2%
	<u>470</u>	<u>100%</u>

3.44 Vacuum Tubes

(H. B. Frost) (UNCLASSIFIED)

During the past two weeks we have had several conferences with IBM engineers on tubes for the AN/FSQ7 program. Mr. Breiding and Mr. Beatty each spent two days in Cambridge working on tube specs.

Test data on the initial shipment of Z-2177 tubes have been compiled by IBM and GE. A limited number of tubes has been tested here. Comparison of these data shows a reasonable correspondence, but equipment differences and tube changes complicate the picture. Some details of these data have been transmitted to the circuit engineers for consideration. Although the Z-2177 is not the same as the 5965, no difficult circuit situations have yet appeared.

Pulsed-current curves have been compiled by MIT and IBM. Examination of the two sets of data shows some systematic differences, but the disagreements do not seem serious. This information should be ready for early transmittal to Sylvania for comparison with data obtained there.

Mr. Frank Vergadamo of Burroughs Adding Machine Company visited the Laboratory on 29 December. He had a series of tubes to be tested as part of the ASTM Interface Task Force program. So far these tubes have been tested by four out of six laboratories for comparison purposes.

Thesis Work

(H. B. Frost) (UNCLASSIFIED)

My efforts during these past two weeks have been devoted to a study of the reasons for the curvature of plots of voltage drop on cathode current. No definite cause can be assigned to this curvature yet.

A re-examination of the literature on this subject showed that Sparks observed a similar curvature in his characteristics. Wright does not show points on his curves, and Eisenstein's work was too dissimilar to be compared with mine.

Some definite conclusions on this study of curvature should be reached within the next several weeks.

(S. Twicken) (UNCLASSIFIED)

First comparison of data on pulse measurements on the 7AK7 of our lab and IBM's shows close agreement on suppressor current. We agree on most of the range of control-grid current, but there is some discrepancy in plate and screen currents. Work toward resolving the differences continues.

3.44 Vacuum Tubes (Continues)

(S. Twicken) (UNCLASSIFIED) (Continued)

Ten 5687's with A31 cathaloy cathodes received from Tung-Sol as engineering samples have been placed on life test. The 4x150A life test has reached 1100 hours. Three of the five conducting tubes have developed excessive grid emission.

Data have been taken on the 5965 and first lots of Z-2177 to determine the difference in plate current between the zero-bias and 200- μ a grid-current points at the 100-v spec point. In the 5965 this difference is less than 1 milliamperes with the positive grid-current point positive in new lots. In the Z-2177's the positive grid-current value is 5-6 milliamperes greater than the zero-bias value.

For the past several weeks, two days per week have been spent in meetings with the IBM Tube Group representatives getting the program under way.

(T. F. Clough) (UNCLASSIFIED)

An analysis of the constructional details and mount geometry of the 5965 and two lots of the developmental Z-2177 is under way.

These data will supplement characteristic data and will be useful during our discussions with the manufacturer.

3.5 Test Equipment

Test Equipment Headquarters

(L. Sutro, A. Bille) (UNCLASSIFIED)

Standard test equipment and oscilloscopes due for test in the two-month period, November and December, have been tested. Commercial test equipment which has not been tested since Test Equipment Headquarters was set up a year ago is now being brought in and tested.

3.6 Drafting

MTC Drawings

(A. M. Falcione) (UNCLASSIFIED)

The first group of marked-up prints from MTC has been received, from which new original drawings will be made. A preliminary review of the situation indicates approximately 4 to 5 months of drafting to complete all drawings for MTC; our goal is to complete them prior to moving to Bedford.

3.7 Administration and Personnel

Terminated Staff

(J. C. Proctor) (UNCLASSIFIED)

M. Geraghty

Terminated Non-Staff

(R. A. Osborne) (UNCLASSIFIED)

Nancy Toorok

Open Non-Staff Requisitions

(R. A. Osborne) (UNCLASSIFIED)

- 1 Clerk-Typist for Group 62
- 2 Electronic Technicians for Group 64
- 2 Messenger Girls
- 1 Senior Detailer